CHAPTER-9
BANK PRODUCTIVITY USING PANEL CAUSALITY TEST

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ABSTRACT

To distinguish the wellsprings of varieties in TFP development crosswise over SCBs in India and the components that can contribute for generally speaking improvement, development and execution of keeping money part in India, the present investigation completed a causality examination. To look at such relationship the present commitment has attempted to ascertain easygoing relationship of TFP records with the money related markers like business per branch, business per worker, NIM/TA, benefit and ROA.It turns out to be fairly hard to find out the profitability of work specifically. Along these lines, to comprehend the idea of work efficiency without other persuasive variables like cost of administrations rendered by the banks could be determined as the proportion of business per representative and business per branch. The matter of business banks can be determined as total of stores in addition to credit. The inception of monetary changes and the passage of new private and remote part banks in India have given impulse of extension of business per worker and business per branch. This has been centered on methods for working up focused and solid condition in the saving money industry in India. The extreme challenge enabled banks to improve their activities in the unbanked territories and trait towards the defense of branches by a few banks. Such methodology helped in the advancement of new business techniques like sharing of ATMs in order to make a cost effective, labor serious saving money and beneficial monetary managing an account framework in India.

Keywords: Panel Causality Test, Panel Granger Causality Test, Cross-Section Dependency Test, Panel Unit Root Test.

9.1 INTRODUCTION

Be that as it may, NIM determined as contrast between the aggregate premiums earned and add up to premium exhausted standardized by resources shows the arrangement of assets to produce pay from task. The nearness of lower proportion portrays beneficial managing an account framework. The expansion in rivalry for the managing an account segment in India has applied descending weight on the spread and hence helped the saving money to improve their dimension of efficiency over the period. This connection among efficiency and NIM ends up essential from a full scale financial perspective given the way that a decrease in the dimension of efficiency is an antecedent to an abating monetary development and expanded weight on b gives a sign to the dimension of benefit created per unit of advantage by the banks in India and it has been expected that higher estimation of the proportion shows higher gainfulness, and subsequently higher profitability. Then again, to be progressively explicit, the benefit earned by the banks at individual dimension under various proprietorships after assessments will mean that enhancement in the proportion will assist the keeps money with decreasing their intermediation cost and along these lines, helps in expanding their dimension of profitability in the cost effective way. In this manner, these money related marker exercises highlight the ascent for estimating the causal association with the dimension of efficiency change crosswise over banks in India over the timeframe.

9.2 PANEL CAUSALITY TEST

To test the casual relationship between performance indicators and TFP score, a pair-wise Dumitrescu Hurlin Panel Causality tests statistics has been estimated after checking the unit root. This approach has been initiated by the study of Dumitrescu-Hurlin, assuming all coefficients to be different across cross-sections. This test statistics can be easily computed by simply running standard Granger Causality regressions approach introduced in Granger for each cross-section individually. In the panel data settings the commonly used least squares regression can take a number of different assumptions made about the structure of the panel data.

$$y_{i,t} = \alpha_{0,i} + \alpha_{1,i} y_{i,t-1} + \alpha_{l,i} y_{i,t-1} + \beta_{1,i} x_{i,t-1} \dots\dots\dots\dots \varepsilon_{i,t}$$
$$x_{i,t} = \alpha_{0,i} + \alpha_{1,i} x_{i,t-1} + \alpha_{l,i} x_{i,t-1} + \beta_{1,i} y_{i,t-1} \dots\dots\dots\dots \varepsilon_{i,t}$$

−1forms, depending upon me period dimension of the panel, and *i i*s the cross-sectional dimension. As stated earlier also that there are alternative approaches to run causality tests in panel data models. Therefore, in the present study, the approach proposed by Hurlin and Venet (2011); Hurlin (2014a); Hurlin (2014b) that treats the autoregressive coefficients and regression coefficient slopes as constant has been incorporated.

The different forms of panel causality test differ on the assumptions made about the homogeneity of the coefficients across cross-sections. The first is to treat the panel data as one large stacked set of data, and then perform the Granger Causality test in the standard way, with the exception of not allowing data from one cross-section to enter lagged values of data from the next cross-section. This method assumes that all coefficients are same across all cross-sections,

$$\alpha_{0,i} = \alpha_{0,j}, \alpha_{1,i} = \alpha_{1,j}, \dots \dots \dots \alpha_{l,i} = \alpha_{l,j} \; \forall \; i,j$$
$$\beta_{1,i} = \beta_{1,j}, \dots \dots \dots \dots \; \beta_{l,i} = \beta_{l,j} \forall \; i,j$$

A second approach adopted by Dumitrescu-Hurlin (2012), makes an extreme opposite thereby, assuming all coefficients to be different across cross-sections

$$\alpha_{0,i} \neq \alpha_{0,j}, \alpha_{1,i} \neq \alpha_{1,j}, \dots \dots \dots \alpha_{l,i} \neq \alpha_{l,j} \; \forall \; i,j$$
$$\beta_{1,i} \neq \beta_{1,j}, \dots \dots \dots \dots \; \beta_{l,i} \neq \beta_{l,j} \forall \; i,j$$

The test is calculated by simply running standard Granger Causality regressions for each cross-section individually. The next step is to take the average of the test statistics, which are termed the Wbar statistic. When the standardized version of this statistic, appropriately weighted in unbalanced panels, follows a standard normal distribution, it is termed the Zbar statistic. The pairwise Dumitrescu Hurlin Panel causality tests may indicate which of the hypotheses are generally consistent or inconsistent with the data

9.3 PANEL GRANGER CAUSALITY TEST

The majority of the study that has been consulted to identify the relationship among the financial variables has focused on the capital market indicators of different countries. In terms of banking efficiency literature, the relationship among efficiency of banks with management quality, loan quality, bank capital and competition has been investigated. The present study is an endeavor for re-establishment of relationship between TFP score and Holtz-Eakins

9.4 CROSS-SECTION DEPENDENCY TEST

There are different set of cross-section dependency tests to test the null hypothesis of zero dependency across the panel decision making units. These tests are applicable to the panel ationary and unit root dynamic heterogeneous panel with structural breaks and are presented with small T (time period) and large sample (N) across cross-sections. Some of the tests include LM Test CD test statics Friedman's test and Frees test Among these test statistics Friedman test statistics, a non-parametric test based on Spearman's rank correlation coffecint has been used to estimate the cross-sectional dependency for the estimates in the present study. The Friedman's test statistics based on the average Spearman's correlation is given as:

$$R_{ave} = \sqrt{\frac{2}{N(N-1)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}\,ij\right)} \rightarrow n(0,1)$$

Where i=1.....represents the cross-sections, $\hat{\rho}\,ij$ is the sample estimate of rank

Correlation estimates of residuals. Large value of R_{ave} indicates the presence of non-zero cross-sectional correlations. The Friedman's test statistics depicts an asymptotically χ^2 distribution with t-1 degrees of freedom, for fixed T and N.

9.5 PANEL UNIT ROOT TEST

In order to check the stationarity of data set, the present study uses panel unit root test rather than simple Augmented Dickey Fuller (ADF) test statistics. The Panel unit root tests are although similar, but not identical, to unit root tests carried out on a time series data.For testing unit root in panel data, two assumptions can be made i.e., either the persistence parameters are common across cross sections ($\rho i = \rho$ for all i, where, ρi are the autoregressive coefficients, i = 1, 2,…..N cross sections units or series) or ρi vary freelyacross cross-sections. Therefore, the present study uses individual panel unit root test like Im, Pesaran, Shin (IPS)", Fisher-ADF", Fisher-Philip Peron (PP)" rather than common unit root test i.e., Levin, Lin, Chu (LLC) test statistics.The assumptions regarding common unit root indicates that the tests are estimated assuming common autoregressive structure for all of the series incorporated in the panel structure. On the other hand, the individual unit root process allows for differentautoregressive

coefficients in each series involved in the panel. IPS begins by specifying the separate ADF regression across the cross sections:

$$\Delta y_{it} = \alpha y_{it} + \sum_{j=1}^{p_i} \beta \Delta y_{it-j} + X'_{it}\delta + \epsilon_{it}$$

The null hypothesis regarding this equation can be written as,

$H_0 = \alpha_i = 0$, for all i

Whereas the alternative hypothesis for the above equation can be written as

$$H_1 = \begin{cases} \alpha_i \neq 0 & for\ i = 1,2,3 \dots \dots N \\ \alpha_i < 0 & for\ i = N+1, N+2, \dots \dots \dots \dots N \end{cases}$$

After estimating the separate ADF regressions, the average of the t-statistics for α_i from the individual ADF regressions is adjusted to calculate the desired test statistics. Having the data set of banks at individual level over the period of time indicates the presence of effect on the operations and other activities of banks individually and it might not be compulsory that the banks in one cross section is going to have effect on the banks in the other cross sections over the period of time. Hence, the appropriate unit root test model for the present study is individual test statistics. In addition to this, IPS test is also made at individual level because selecting an individual test type helps better control over the computational method and provides additional detail on the test results.Another important indicator is regarding the lag values. Hence, for the group or pool unit root test, the automatic selection of lags has been incorporated which involves information matrix criterion based on the number of lag difference terms and the Andrews or Newly-West method for bandwidth selection. The null hypothesis for the IPS, ADF and tests in the present study, includes that the data series of different determinants namely business per branch, business per employee, ratio of net interest margin to total assets, profit per employee, profit, return on assets and dTFP score have unit root.

Figure 9.1: Productivity-Profitability Matrix for Public Sector Banks

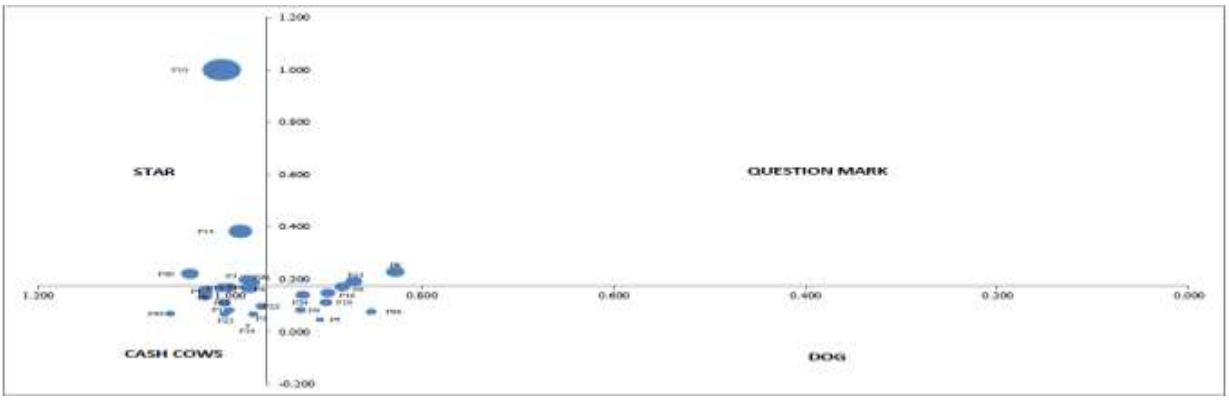


Figure 9.2: Productivity-Profitability Matrix for Private Sector Banks

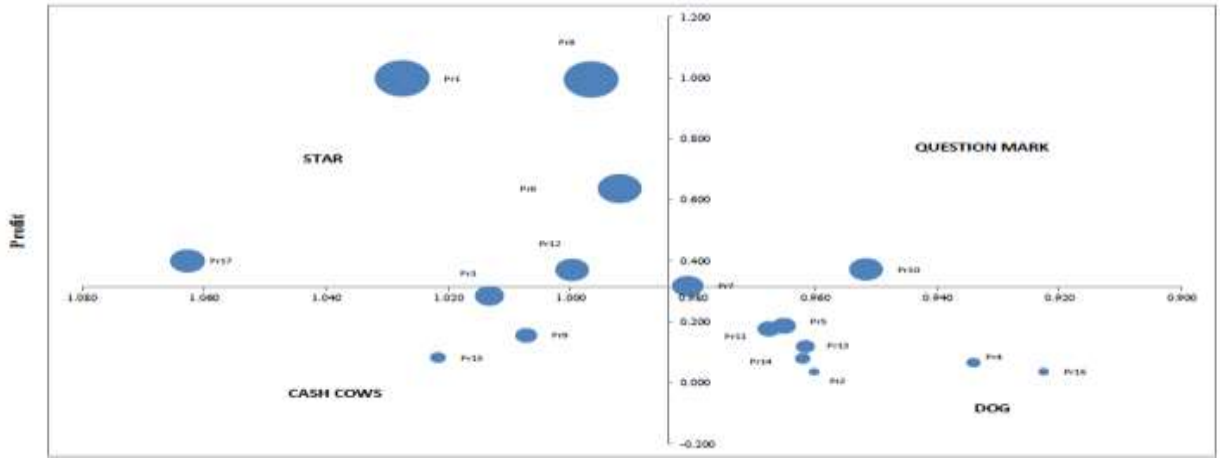
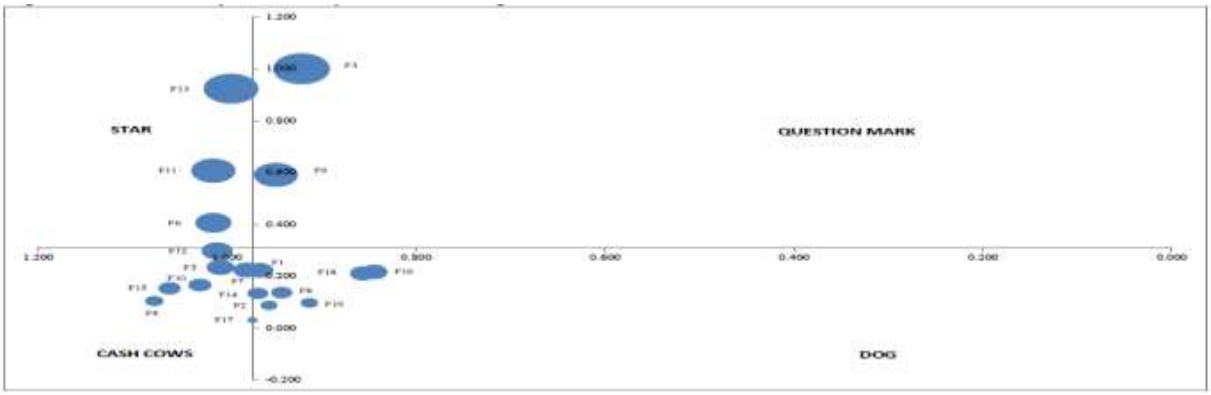


Figure 9.3: Productivity-Profitability Matrix for Foreign Sector Banks



So as to decide if there is easygoing relationship among the efficiency change and saving money execution markers, a couple savvy Dumitrescu-Hurlin Panel Causality tests has been utilized. Be that as it may, before continuing for the test, it is important to look at the cross-sectional reliance (CD) and stationarity of the information fused in the present undertaking. On the off chance that the information gives off an impression of being non-stationary, the typical asymptotic test measurements for the board causality stays invalid. In this manner, it ends up indispensable to show such informational index into the stationary shape and guarantee their dimension of stationarity before continuing further

The cross-segment reliance test proposed by Friedman (1937) has been utilized to test the invalid theory of zero reliance over the board basic leadership units. It is essentially required on the off chance that there is T (timespan) little and N (test estimate in cross area) expansive information. It is further to be kept in notice that the test for cross-sectional reliance neglects to dismiss the invalid theory when there is nearness of dynamic panle information with zero-mean in cross-sectional measurements. Friedman's test, a non-parametric test based Spearman's rank relationship coefficient has been utilized to estimates the cross-sectional reliance test for the estimates. The outcomes from Table 1.1 propose that the invalid theory of cross-area reliance is dismissed by utilizing Friedman tests measurements. This implies for bank aggregate there is no cross-sectional reliance, any stun in one bank in a cross-area can't be transmitted to another. In this way, the outcome uncovers that $\chi 2$ insights isn't measurably noteworthy. It prompts the acknowledgment of invalid speculation. Thus, there does not seem any cross-sectional reliance for the board information over the markers utilized in the proposed model.

Further to check the stationarity of informational index, the present examination utilizes board unit root test as opposed to basic ADF test insights. The investigation includes singular board unit root test like Im, Pesaran, Shin", Fisher - ADF", Fisher - PP". The suppositions with respect to normal unit root assigns that the tests are evaluated expecting a typical AR structure for the majority of the seriesincorporated in the board structure, while then again, the individual unit pull process endorse for various AR coefficients in every arrangement engaged with the board. Having the informational index of banks at individual dimension over the timeframe ensure the nearness of impact on the tasks and different exercises of banks independently and it may not be vital that the banks in a single cross segment will affect the banks in the traverse the timeframe. Thus the suitable unit root test demonstrate in the present investigation is singular test insights. Likewise, the utilization of Im, Pesaran, Shin test is likewise made at individual dimension simply because choosing an individual test type permits you

better command over the computational technique and gives extra detail on the test outcomes. Another critical pointer is with respect to the slack qualities. Henceforth, for the gathering or pool unit root test, the programmed determination of slacks has been consolidated that includes the data grid foundation based for the quantity of slack distinction terms and the Andrews or Newey-West strategy for transfer speed choice. Thusly, the slack qualities present in the insights were based on defaults esteems.

Table 9.1: Cross-Sectional Dependence Test for Panel Data

Test	Statistic	df	Prob.
Friedman Chi-square	10.682	18	0.907

Note: Friedman's test statistic showed an asymptotically χ^2 distribution with T-1 degrees of freedom
Source: Authors' calculations

Note: Friedman's test statisticdistributionwithT-1showeddegreesoffreedoman asymptotic Source: Authors' estimations The invalid theory of the board unit root test is that the factors associated with the insights are having the unit root. The test insights for every one of the factors in the example are appeared in the Table 9.1. The test outcomes affirm the nearness of stationarity for the informational collection everything being equal, along these lines, dismissing the invalid speculation of unit root. At the end of the day, the affirmation of Im, Pesaran and Shin, W-detail; ADF-Fisher, Chi-square; PP-Fisher, Chi-square measurements not exactly the basic estimation of 1, 5 and 10 percent huge dimension validate the dismissal of invalid speculation, in this way, affirming the nonappearance of unit root. The outcomes delineates that the all the variable specifically BS/BRANCH, BUS/EMP, DTFP, NIM/TA, PROFIT and ROA consolidated in the model are stationary at level and in this way can be utilized for further vadaition of connections. The outcome further affirms that there is no critical pattern in their time development too. The probabilities for Fisher tests are figured utilizing an asymptotic Chi-square dispersion and every other test expect asymptotic ordinariness.

Presently, subsequent to looking at unit root, the investigation has continued to do the estimates with respect to the causality test. To test the easygoing connection among dTFP and different profitability pointers, a couple savvy Dumitrescu-Hurlin Panel Causality tests insights has been evaluated. The methodology started by the investigation of Dumitrescu-Hurlin (2012), enables all coefficients to be distinctive crosswise over cross-areas. This test measurements can be effortlessly processed by basically running standard Granger Causality relapses approach presented in Granger (1969) for each cross-area exclusively. In the board information settings the usually utilized minimum squares relapses can take

various diverse structures, contingent on suppositions made about the structure of the board information. Since, Granger Causality is processed by running bi-variate relapses there are various distinctive ways to deal with testing for Granger Causality in a board setting.

The distinctive types of board causality test contrast on the presumptions made about the homogeneity of the coefficients crosswise over cross-segments. The two methodologies are again featured to test the causality test in board informational index. The principal approach regards information as one expansive staked informational index and plays out the Granger causality test in such a route by not letting the information to enter from one cross segment to the slacked estimations of information from next cross segment. Thus, it accept all coefficients same over every single cross-area. Then again, the second methodology embraced by Dumitrescu-Hurlin (2012), makes an extraordinary inverse supposition, enabling all coefficients to be diverse crosswise over cross-segments. Subsequently, the present examination utilizes the second way to deal with direct the causality test as this test is determined by essentially running standard Granger Causality relapses for each cross-segment independently.

To affirm the legitimacy of investigation factually the normal of the test measurements named as Wbar measurement must be thought about. These insights delineates that the institutionalized variant that are properly weighted in lopsided boards, pursues a standard typical dissemination and such conveyance is measured with help of Zbar measurement. To check the solidness of results while estimating the easygoing relationship among factors, the present investigation evaluated the incentive at period slack which is self-assertive by and by. From the Table 1.3, it very well may be finished up by the estimates that for match savvy Dumitrescu-Hurlin test, the invalid speculation that Business per branch does not homogeneously cause dTFP, dTFP does not homogeneously cause Business per branch; Business per representative does not homogeneously cause dTFP, dTFP does not homogeneously cause Business per worker; NIM/TA does not homogeneously cause dTFP, dTFP does not homogeneously cause NIM/TA; Profit does not homogeneously cause dTFP; dTFP does not homogeneously cause Profit; ROA does not homogeneously cause dTFP and dTFP does not homogeneously cause ROA is dismissed in every one of the cases.

For making the investigation progressively reasonable, the estimates have been determined at the higher slacks additionally and it has been uncovered from the outcomes that there is a measurably huge and reciprocal directional connection between these budgetary markers at 1 percent dimension of criticalness

with the exception of the ROA and dTFP which seems to delineate the noteworthy bi-directional relationship at 5 percent dimension of noteworthiness. The bi-directional connection between TFP score and different pointers of bank execution are very clear.

The outcomes presume that higher profitability demonstrates a solid economy and incites feel great opinions among the planned business banks in India that are giving distinctive sort of administrations to their clients. Further the outcomes from the Table 1.3 features positive coefficient for all the profitability markers, along these lines, demonstrating that dTFP scores emphatically cause the efficiency pointers and the other way around. The essentialness of the measurements for the first and second slacks of profitability development appear to propose that adjustment in the dimension of efficiency is influenced altogether by earlier years profitability score and by pointers of efficiency development. The outcomes from the Table 1.3 propose that the general advancement and development of managing an account division prompts the enhancement in the general business and productivity of banks. Then again, the gainfulness, business per representative, enhancement in the net premium edge leads towards the improvement in the dimension of efficiency change and its separate parts for the managing an account division in India. In addition, the bi-directional connection between the business/representative, business/branch, NIM/TA with dTFP delineates factually solid relationship as evaluated from the given measurements.

Table 9.2: Summary Statistics of Panel Unit Root Test

Null Hypothesis: Unit root (assumes individual unit root process)						
Method	BS/BRANCH	BUS/EMP	DTFP	NIM/TA	PROFIT	ROA
Im, Pesaran and Shin W-stat	-5.843**	-2.761**	-10.262**	-9.215**	-10.483**	-10.656**
ADF - Fisher Chi-square	234.155**	198.172**	313.146**	284.610**	458.799**	324.101**
PP - Fisher Chi-square	755.795**	149.647**	995.420**	315.439**	446.047**	303.256**

The cautious comparision of the acquired Panel Granger Causality and the W and Zbar measurements permits in the present examination to infer that the causality running from the pointers to add up to factor profitability and the other way around are plainly positive, in this way, featuring the nearness of sound impact of separate markers on the aggregate factor efficiency change in saving money segment of

India. Generally speaking, the outcomes appear to recommend causality running from profitability pointers to dTFP scores is moderately solid. In this way, the outcomes infer that there is have to make more quickening in efficiency which is related with significant markers of saving money industry in India to defeat from the relapse looked by industry over the timeframe. To close the dialog, it very well may be uncovered from the investigation thatx efficiency pointers like business per branch, business per representative, benefit and profit for resources are subject to the dimension of profitability amid the time of concentrate as the insights has all the earmarks of being on higher side. Chi-square dispersion. Every single other test accept asymptotic typicality. Programmed slack length choice dependent on SIC: 0 to 3. Newey-West programmed transfer speed choice and Bartlett portion

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Table 9.3: Pair-Wise Dumitrescu-Hurlin Panel Causality Test

Null Hypothesis:	Lags: 1			Lags: 2		
	W-Stat	Zbar-Stat	Prob	W-Stat	Zbar-Stat	Prob
Business/Branch does not homogeneously cause dTFP	1.831	2.563	0.01	3.442	2.224	0.026
dTFP does not homogeneously cause Business/Branch	55.995	216.34	0	56.583	127.616	0
Bus/Employee does not homogeneously cause dTFP	3.546	9.331	0	5.536	7.164	0
dTFP does not homogeneously cause Bus/Employee	78.391	304.681	0	73.502	167.54	0
NIM/TA does not homogeneously cause dTFP	2.977	7.084	0	5.528	7.146	0

dTFP does not homogeneously cause NIM/TA	162.249	635.63	0	208.453	485.978	0
Profit does not homogeneously cause dTFP	1.929	2.95	0.003	3.102	2.42	0.021
dTFP does not homogeneously cause Profit	6.517	21.054	0	7.774	12.444	0
ROA does not homogeneously cause dTFP	2.568	2.525	0.072	3.371	2.057	0.039
dTFP does not homogeneously cause ROA	199.302	781.822	0	6.221	8.78	0

The following hypothesis has been used in the present study to empirically examine the relationship:

H_0: Business per Branch does not homogeneously cause dTFP

H_0: dTFP does not homogeneously cause Business per Branch

H_0: Business per Employee does not homogeneously cause dTFP

H_0: dTFP does not homogeneously cause Business per EmployeeH_0: NIM/TA does not homogeneously cause dTFPH_0: dTFP does not homogeneously cause NIM/TA

H_0: Profit per Employee does not homogeneously cause dTFP

H_0: dTFP does not homogeneously cause Profit per Employee

H_0: ROA does not homogeneously cause dTFPH_0: dTFP does not homogeneously cause ROA

9.6 CONCLUSION

The positive connection between profitability score and different markers of bank execution are very clear. The outcomes infer that higher efficiency demonstrates sound economy and actuates feel great notions among business banks in India that are giving diverse kind of administrations to their clients.

The positive and reciprocal relationship affirmed by Dumitrescu-Hurlin Panel causality test between profitability score and execution markers of efficiency demonstrates a solid economy and instigates feeling of soundness among business banks in India while giving administrations to their clients.The banks working close to the unhindered outskirts are not working at the MPSS and in this way, need to address their scale measure to work at the ideal scale of generation. Consequently, on a normal, dRISE means that while holding the input and yield blend settled and enabling the dimension to differ banks even in the wake of changing the scale of activity are appearing and are working underneath the dimension of MPSS. At last, the banks in India need to concentrate on improving their scale measure, defeat their significant scale wasteful aspects in order to work at the ideal effective wilderness.

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